A ZOOLOGY OF THE FUTURE

AFTER MAN

BY DOUGAL DIXON INTRODUCTION BY DESMOND MORR

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BY DESMOND MORRIS

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FOR
GAVIN

The author and publishers would like to express their thanks to the illustrators of this book. They are Diz Wallis (represented by Folio); John Butler and Brian McIntyre (represented by Ian Fleming and Associates Ltd); Philip Hood; Roy Woodard (represented by John Martin and Artists Ltd); and Gary Marsh

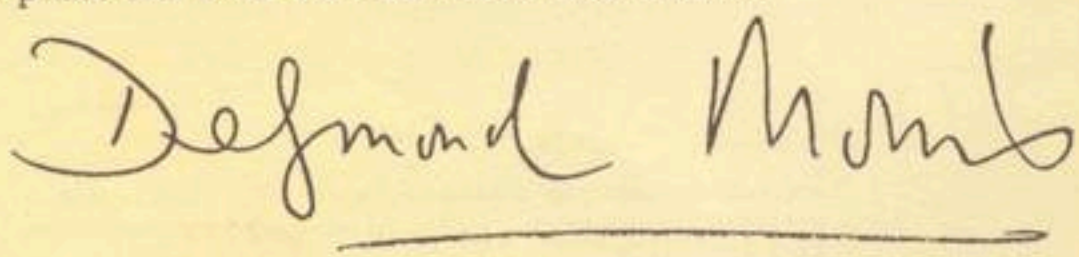
INTRODUCTION BY DESMOND MORRIS

As soon as I saw this book, I wished I had written it myself. It is a marvellous idea, beautifully presented. Many years ago, as a young zoologist, I started inventing imaginary creatures, drawing and painting them as an enjoyable contrast to the demands of my scientific studies. Released from the restrictions of evolution as it really is, I was able to follow my own, private evolutionary whims. I could make monsters and strange organisms, plant-growths and fabulous beasts of any colour, shape and size I liked, letting them change and develop according to my own rules, giving my imagination full rein. I called them my biomorphs and they became as real to me as the animals and plants of the natural world.

Dougal Dixon's mind has obviously been working in a similar way, although the creatures he has brought to life are very different from mine. Instead of inventing a parallel evolution, as though it were taking place on another world, he has given himself the intriguing task of contemplating a future evolution on our own planet, closely based on species that exist at present. By waving a time-wand and eliminating today's dominant species, including man, he has been able to watch, through his mind's eye, the lesser animals gradually taking over as the major occupants of the earth's surface.

Setting his scenario in the distant future, about 50 million years from now, he has given the members of his new animal kingdom time to undergo dramatic changes in structure and behaviour. But in doing this he has never allowed himself to become too outlandish in his invention. He has created his fauna of the future so painstakingly that each kind of animal teaches us an important lesson about the known processes of past evolution – about adaptation and specialization, convergence and radiation. By introducing us to fictitious examples of these factual processes, his book is not only great fun to read but also has real scientific value. The animals on these pages may be imaginary, but they illustrate vividly a whole range of important biological principles. It is this – the way in which he has perfectly balanced his vivid dreamings with a strict scientific discipline – that makes his book so successful and his animals so convincing and, incidentally, so superior to the often ridiculous monsters invented by the cheaper brands of Science Fiction.

The only danger in reading this delightful volume is that some of you may reach the point where you suddenly feel saddened by the thought that the animals meticulously depicted in it do not exist now. It would be so fascinating to be able to set off on an expedition and watch them all through a pair of binoculars, moving about on the surface of today's earth. Personally, I feel this very strongly as I turn the pages and there is probably no greater praise that I can offer the author than that. . . .



EVOLUTION

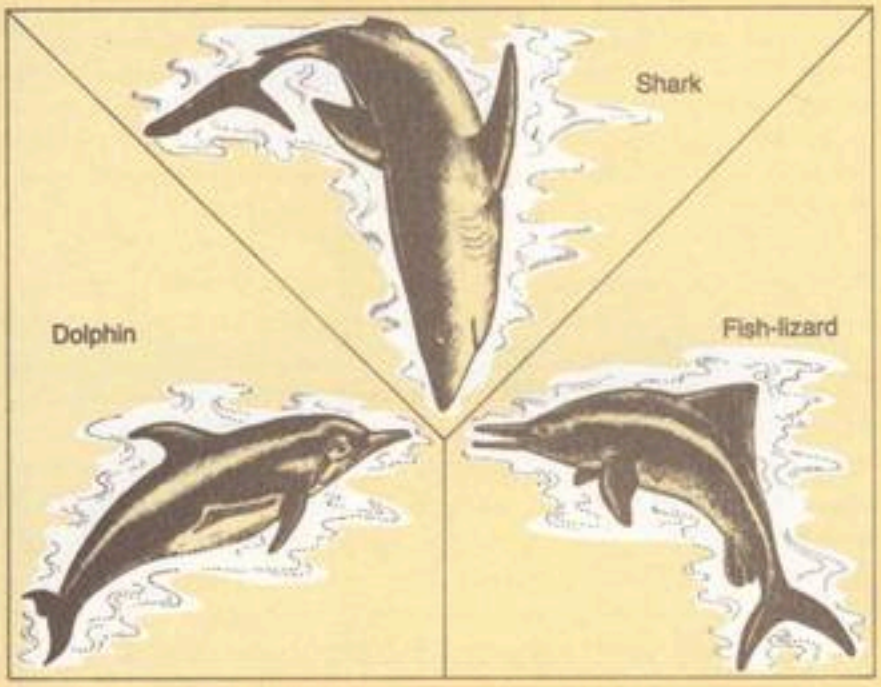
The biological cell, shown here in the process of replicating itself, is the fundamental building block that makes up all living things. The cell's capacity for infinite variation, when taking part in sexual reproduction, is at the root of evolutionary development.

The form and position of living things on earth can be attributed
to two things – evolution and environment. The study of evolution explores how life originated,
how it diversified the way it did and how different creatures have
developed from others. The study of a creature's environment (ecology) shows how
the various life forms interact with one another and how they interact with the environment they inhabit.
In other words evolution can be thought of as showing a longitudinal section
through the life of our planet while ecology shows the same situation in cross-section.
Each is inextricably entwined with the other and the two cannot be studied totally independently.
Although both aspects deal with survival it should not be forgotten
that extinction is a very important factor. Without it there would be no room for evolution
to take place. There would be no new ecological situations for nature to fill by the evolution of new
animals and plants from older stocks.
That evolution has taken place is apparent both from the fossil record
and from the evidence contained within living plants and animals.
Examination of fossil remains reveals a general development from the simple to the more
complex and also the part played by the environment
in shaping an organism to prevailing conditions. In living creatures,
comparability in structure, embryonic development and chemistry are powerful indications of similar
evolutionary history or of common ancestry.
Evolution is therefore not a process that has happened only in the past in order
to establish the animals and plants of today's ecology, but is a constantly continuing
process that we can study both from its results and from the fossil evidence of the past. It has happened,
it is happening now and it will continue to happen as long as life remains on this planet.

EVOLUTION

FORM AND DEVELOPMENT

Natural selection lays down rules about precisely which form of life is most suitable for colonizing a particular environment. This evolutionary feature can give rise to a large number of different animals with the same superficial appearance. When the animals concerned have evolved from the same ancestor and have developed independently along similar evolutionary lines, they are said to have evolved in parallel. When the ancestors are different and the animals have evolved along quite different lines to produce the same final shape, their evolution is called convergent. An example of parallel evolution can be seen in the development of *Equus*, the horse, which appeared at the end of the Tertiary in North America, and *Thoatherium*, a remarkably similar ungulate which evolved at the same time in the then isolated continent of South America. The two forms developed independently along similar lines from similar ungulate ancestors in response to the same set of environmental



Of the shark, fish-lizard and dolphin, only the shark has evolved from a marine creature. The fish-lizard and dolphin were evolved from a land-living reptile and mammal respectively. Despite their radically different ancestry they have all adopted the same streamlined form to suit their aquatic mode of life, and together form a striking example of convergent evolution.

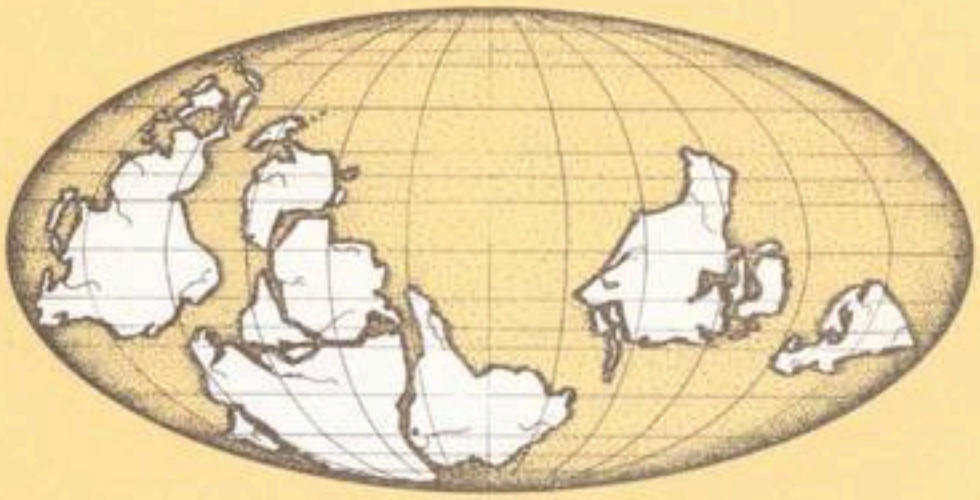
conditions. An example of convergent evolution is found in the development of the shark, *Carcharodon*, the fish-lizard, *Ichthyosaurus*, and the dolphin, *Delphinus* – three animals from totally different classes but having adopted the same streamlined shape, swimming fins and tail in order to exploit the same niche in the same environment, that of active fish-eaters in the sea.

One consequence of particular animal shapes fitting particular ecological niches is that widely separated places with the same climatic and environmental conditions may support very similar faunas even though they have evolved from different stocks. The tropical grasslands of South America, Africa and Australia all at one time supported animals with similar physical characteristics – long-legged, running grazers, swift carnivores, burrowing insectivores and slow-moving heavy browsers. In Australia they were marsupial, in Africa placental and in South America of both types. Despite their differing ancestry many of these creatures were outwardly similar. Such situations arise not only in different places at the same time, but also in different places at different times.

The influence of latitude on animal shape and form has two oddly contrasting effects. One known as Bergman's rule predicts that, within related groups, animals living nearer the poles will be larger. The other, Allen's rule, states that, again in related groups, those living nearer the poles will have smaller extremities. Both effects are heat-conservation measures designed on the one hand to preserve body temperature and on the other to prevent frostbite.

Genetic changes may be minor and quite imperceptible or they may result in changes that alter the species dramatically. The land snail, *Cepaea memoralis*, lives in a variety of habitats in the temperate woodland and can have any of several different shell markings. Where the ground is open and grassy a plain yellow coloration disguises the snail best and snails with other markings are easily seen by predators and quickly devoured. Where the ground is covered by leaf litter, brown striped forms are better camouflaged and other forms are selected against. This gives rise to populations of predominantly yellow snails in open grassy areas and brown striped snails in woodland. A similar effect was observed in the peppered moth, *Biston betularia*, during the early days of man's industrial revolution. Up until then the species had consisted largely of grey and white speckled individuals which were perfectly camouflaged against the lichen-covered tree trunks where they lived. A black form also found in the population was easily seen and eaten by birds and was therefore uncommon. With the arrival of heavy industry the trees became caked with soot and turned black, affording a perfect camouflage background for the black form. The white form was then selected against by predators and the moth population became predominantly black. Later, with the coming of clean air laws, the atmosphere and the tree trunks became less soot-laden and the moth population swung back to give a bias towards white and grey individuals once more. These changes involved only varieties within the same breeding population and there was at all times a constant exchange of genetic material as they took place. If, however, the environmental changes had been permanent and the

HISTORY OF LIFE



The map shows the configuration of the continents at the beginning of the Cambrian, the point in time from which the history of life can be traced with some certainty. In Precambrian times most animals were soft-bodied and are only rarely preserved.

The earth has existed for about 5000 million years and has been
populated by organisms of one sort or another for between 3500–4000 million years of that time.
However, an accurate fossil record of the earth's
life can only be traced back some 620 million years – to the time when hard skeletons
first came into existence. At that time life was present only in the sea and the land was barren.
The distribution of land and sea was not as it is today. The configuration
of the continents and oceans is constantly changing due to a mechanism called plate
tectonics. The earth's crust is made up of a number of plates, like the panels of a football.
These plates are formed continually along one edge, where material wells up from the earth's interior,
and are destroyed at another, where one plate slides beneath a neighbouring one and is lost.
The upwelling takes place along mid-oceanic ridges and the destruction occurs along deep-sea
troughs. The material involved consists of oceanic crust, rich in silica and magnesia.
The continents are made of a different sort of crust, rich in silica and aluminium, which, being
lighter, remains on top so that the continents are carried here and there over the
globe by plate-tectonic activity. This process has continued throughout geological time and
will continue until the end of the world. The importance of plate tectonics to the
history of life on earth is not just one of geography.
Plate tectonics in part affects the pattern of global climate, which in geological terms fluctuates
over a comparatively short space of time, and has undoubtedly
contributed to the relatively sudden changes that have occurred in the predominant life form on earth.
The juxtaposition of continents at crucial stages in the development of these animals has at
certain times been important in their spread throughout the world
and has produced marked differences between forms found on different land masses.

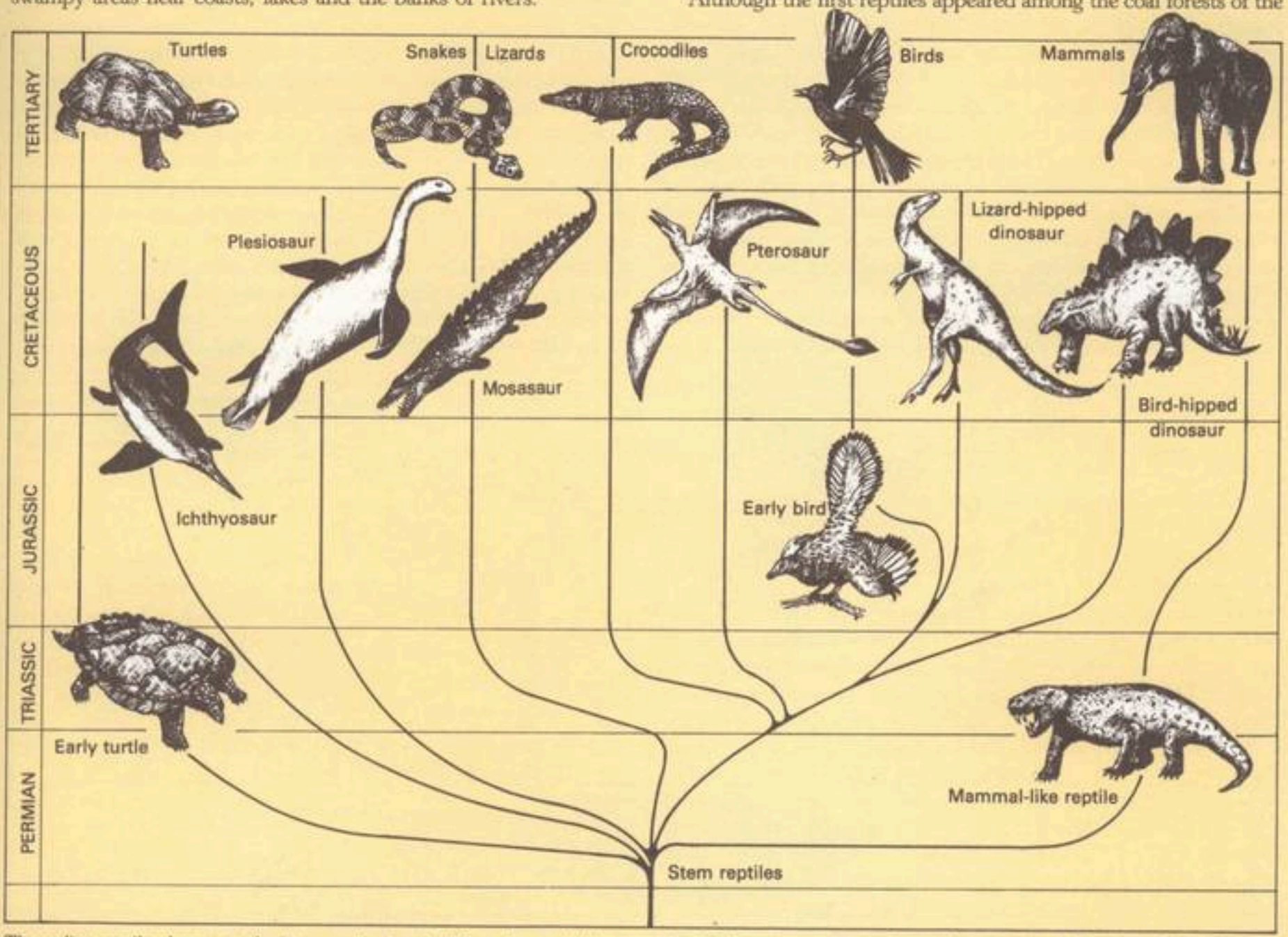
HISTORY OF LIFE

THE AGE OF REPTILES

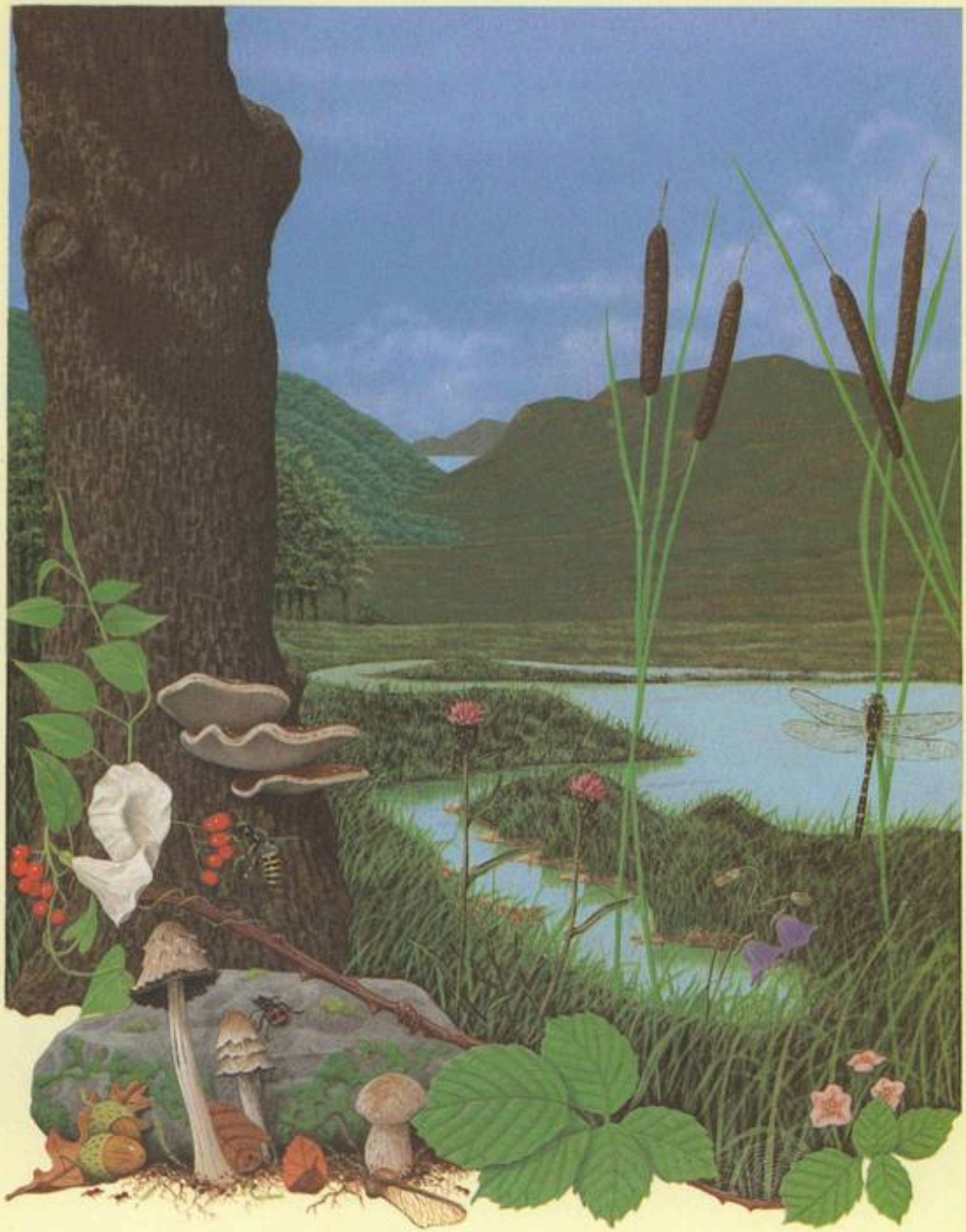
The reptiles were the first completely land-living vertebrate animals on earth. The amphibians from which they had evolved were reasonably well adapted to life on land, but always had to return to the water to breed, and the immature stages always, of necessity, had to lead a completely aquatic tadpole existence. This meant, in effect, that amphibian colonization of the land was confined to swampy areas near coasts, lakes and the banks of rivers.

The reptilian development that extended this range was the development of the hard-shelled egg, which, by means of impermeable membranes, enabled the embryo animal to develop in its own private armoured pool away from water. In addition the reptiles also had tough skins that resisted desiccation to a much greater extent than those of the amphibians.

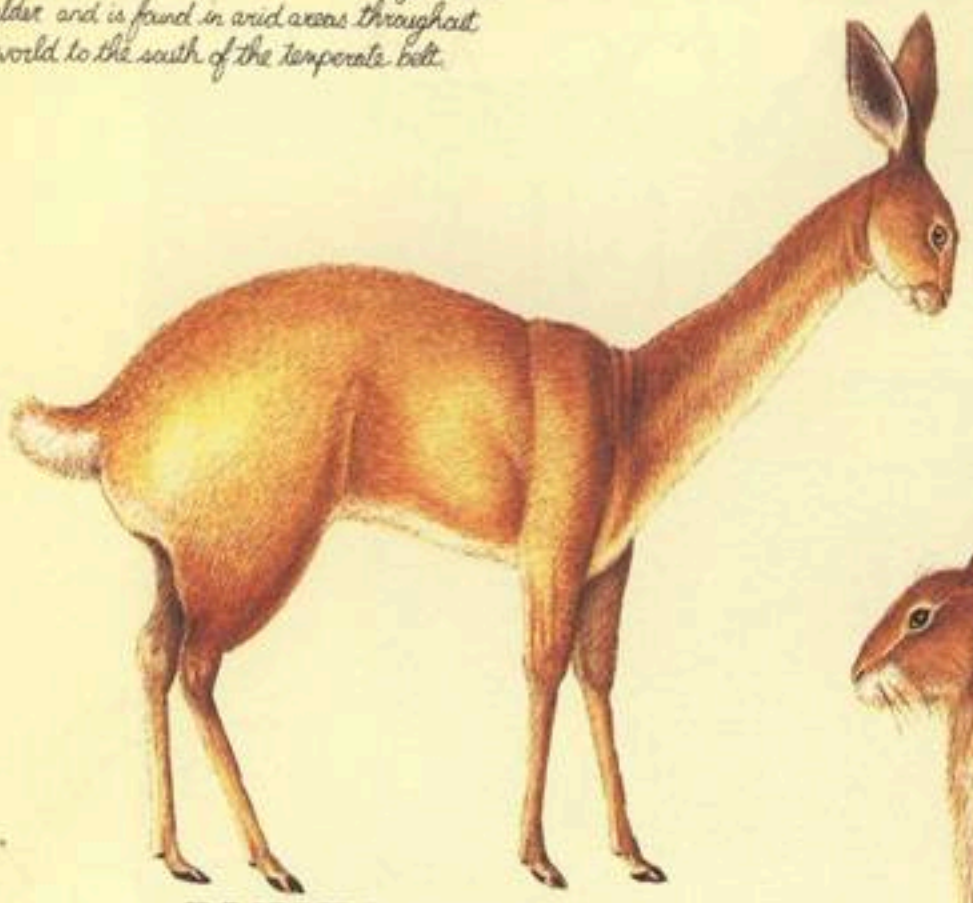
Although the first reptiles appeared among the coal forests of the



The earliest reptiles, known as the "stem reptiles", evolved from the amphibians in the Carboniferous and developed into a variety of forms that filled all the major environmental realms – air, land and water. The ichthyosaurs, plesiosaurs and mosasaurs were aquatic, the pterosaurs were aerial and the dinosaurs and mammal-like reptiles were terrestrial. The dinosaurs (the terrible lizards) are classified in two groups according to the structure of their hips. Oddly, the birds are descended from the lizard-hipped group, not as one might expect from those with bird-like hips. As often occurs in nature, where lack of sophistication implies adaptability, the crocodile shape, one of the earliest reptilian forms to evolve, ultimately proved most successful.



A much more lightly built creature with long ears and a short sandy-coloured coat, the desert rabbuck stands no more than 1·2 metres high at the shoulder and is found in arid areas throughout the world to the south of the temperate belt.



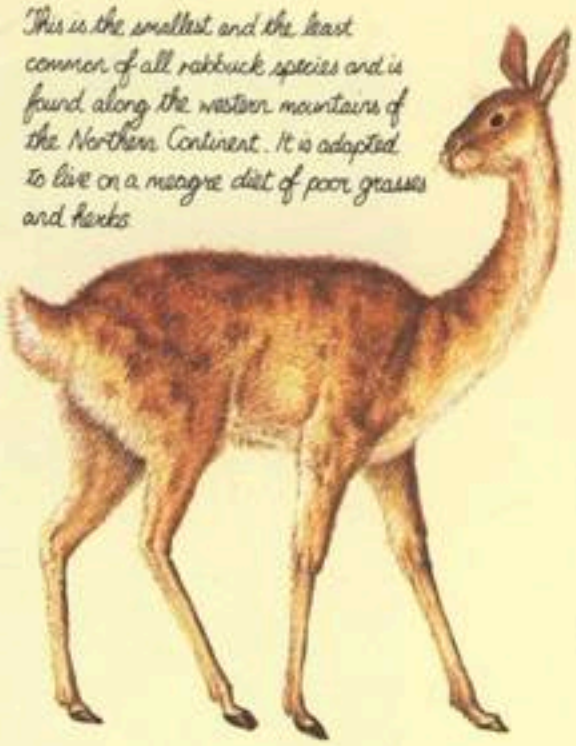
DESERT RABBUCK

Ungulagus flavus

MOUNTAIN RABBUCK

Ungulagus scandens

This is the smallest and the least common of all rabbuck species and is found along the western mountains of the Northern Continent. It is adapted to live on a meagre diet of poor grasses and herbs



COMMON RABBUCK

Ungulagus silvicultrix

Heavily built with rolls of insulating fat, the Arctic rabbuck is found in the far north, in the region of the tundra and coniferous forest.

The Arctic rabbuck has a thick hairy coat which turns white in the winter.

ARCTIC RABBUCK

Ungulagus hirsutus

The forest-dwelling rabbuck of temperate latitudes is the archetypal species of the genus Ungulagus. It grows to around 2 metres high and has a dappled coat which camouflages it effectively among the trees. They are normally found in small herds of between ten and twelve individuals

When rolled-up the testadon forms a complete sphere

The testadon has an overall length of 30 cm

Leaf outgrowth dyed green by mature fluke.

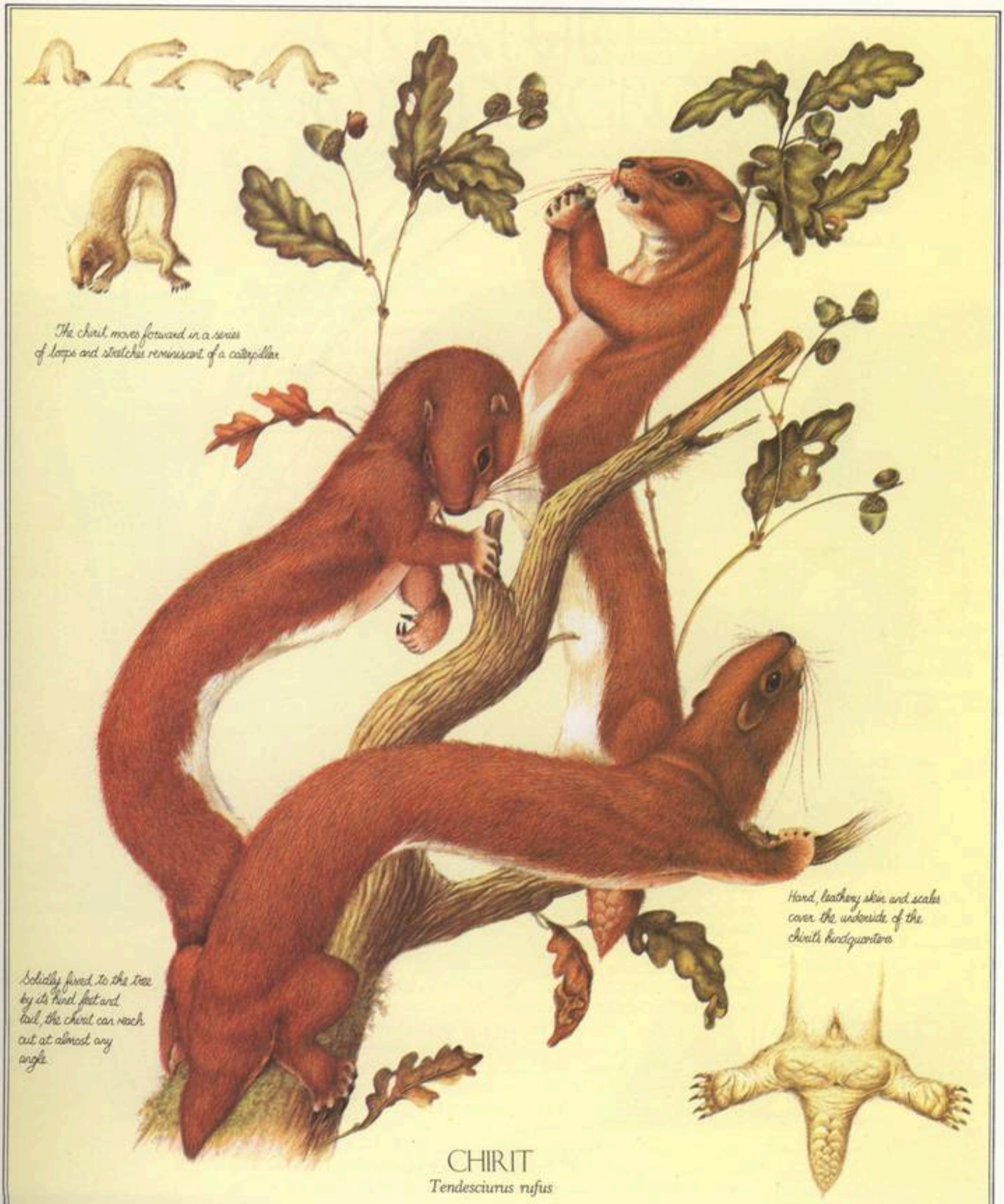
TESTADON

Armatechinos impenetrabilis

Untanned leaf outgrowth providing camouflage.

OAKLEAF TOAD

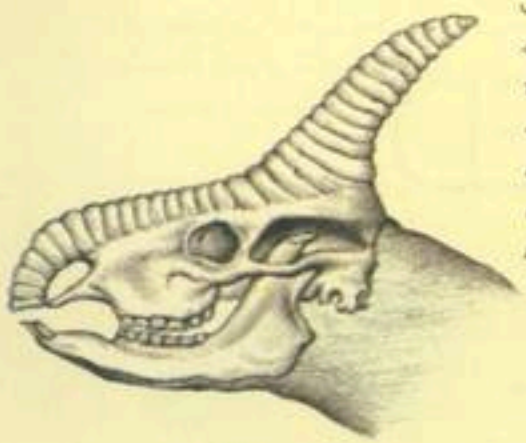
Grima frondiforme


The chirit moves forward in a series of leaps and stretches reminiscent of a caterpillar
Solidly fixed to the tree by its hind feet and tail, the chirit can reach out at almost any angle
Hard, leathery skin and scales cover the underside of the chirit's hindquarters

CHIRIT

Tendesciurus rufus

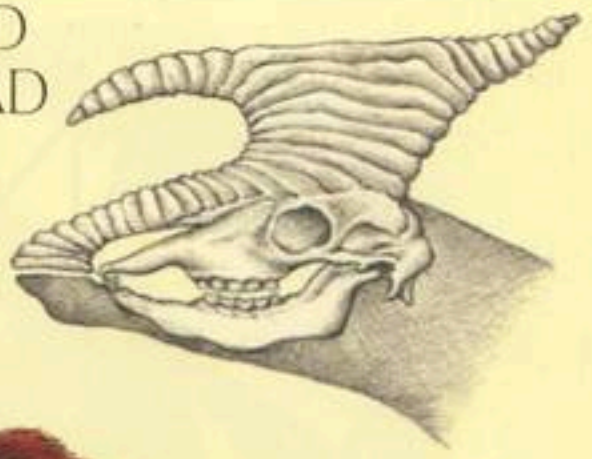
The purrip bat's sonar equipment is typical of most temperate woodland bats.
PURRIP BAT
Caecopterus sp.
TRUTEAL
Terebradens tubauris
The trutteal has an overall length of about 12 centimetres
The trutteal uses its long beak to probe deep into the earth for worms and grubs.



The later hornheads, such as the common hornhead, have longer lower jaws and bite by bringing the lower incisor teeth into contact with the upper horn lip.

HELMETED HORNHEAD

Cornudens horridus



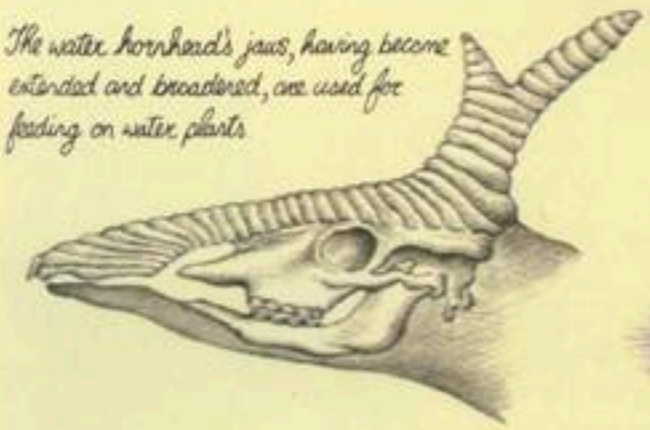
Like its antelope ancestors, the helmeted hornhead - the most primitive surviving hornhead - bites by bringing its lower incisors into contact with a bony pad in the upper jaw.

COMMON HORNHEAD

Cornudens vulgaris

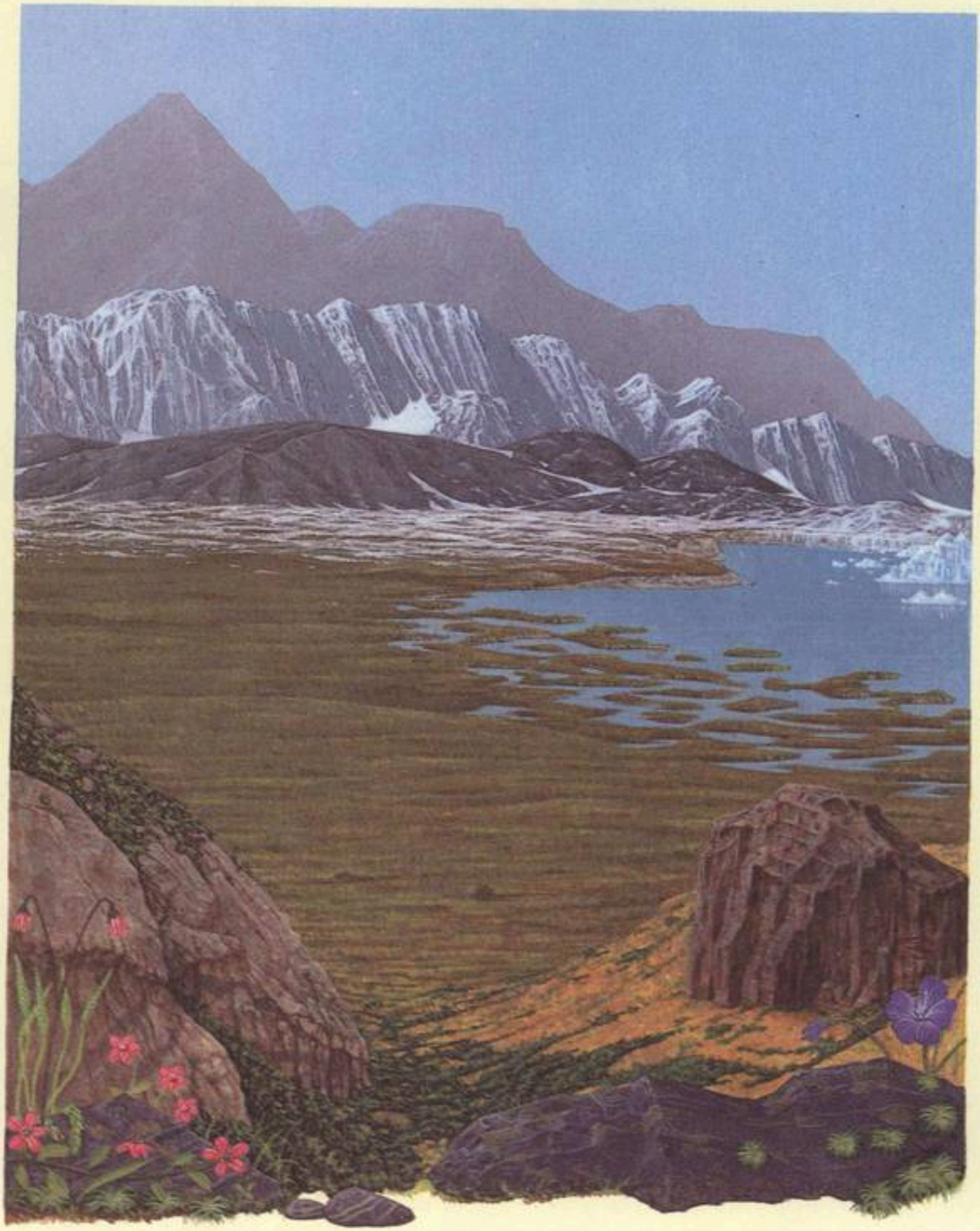
Hornheads stand about 2 metres high at the shoulder. Their horns, originally developed for a defensive role, have evolved since as browsing tools.

The water hornhead's jaws, having become extended and broadened, are used for feeding on water plants.



WATER HORNHEAD

Cornudens rastrostrius



BARDELOT

Smilomys atrox

Male bardelot

Female bardelot

Pouch for sabre teeth

The female's sabres are formed from the outer crowns of its two front teeth – a pattern derived from that of the predator rat.

Woolly gigantelope with winter coat and fatty hump

WOOLLY GIGANTELOPE

Megalodorcas borealis

The large forward-pointing horns are used to clear snow from the vegetation in winter

Woolly gigantelope with summer coat – scruffy patches of winter coat remain throughout most of the summer

Distarterops are gregarious creatures and are often found resting on ice-floes during the summer months in small groups containing both males and females.

The females' tusks both curve downwards, whereas the males' tusks point in different directions.

DISTARTEROPS

Scinderedens solungulus

In all cases the male's forward-pointing tusk is formed by the left-hand upper incisor and similarly only its left-hand flipper is endowed with a claw.

FLIGHTLESS AUK

Nataralces maritimus

The animal life of mountainous areas is found at high altitude only during the summer months. In winter, when the snows come, herbivores such as the groaths move to lower levels to find shelter and grazing. The carnivorous animals, dependent on them for food, closely follow the herds on their seasonal migrations.

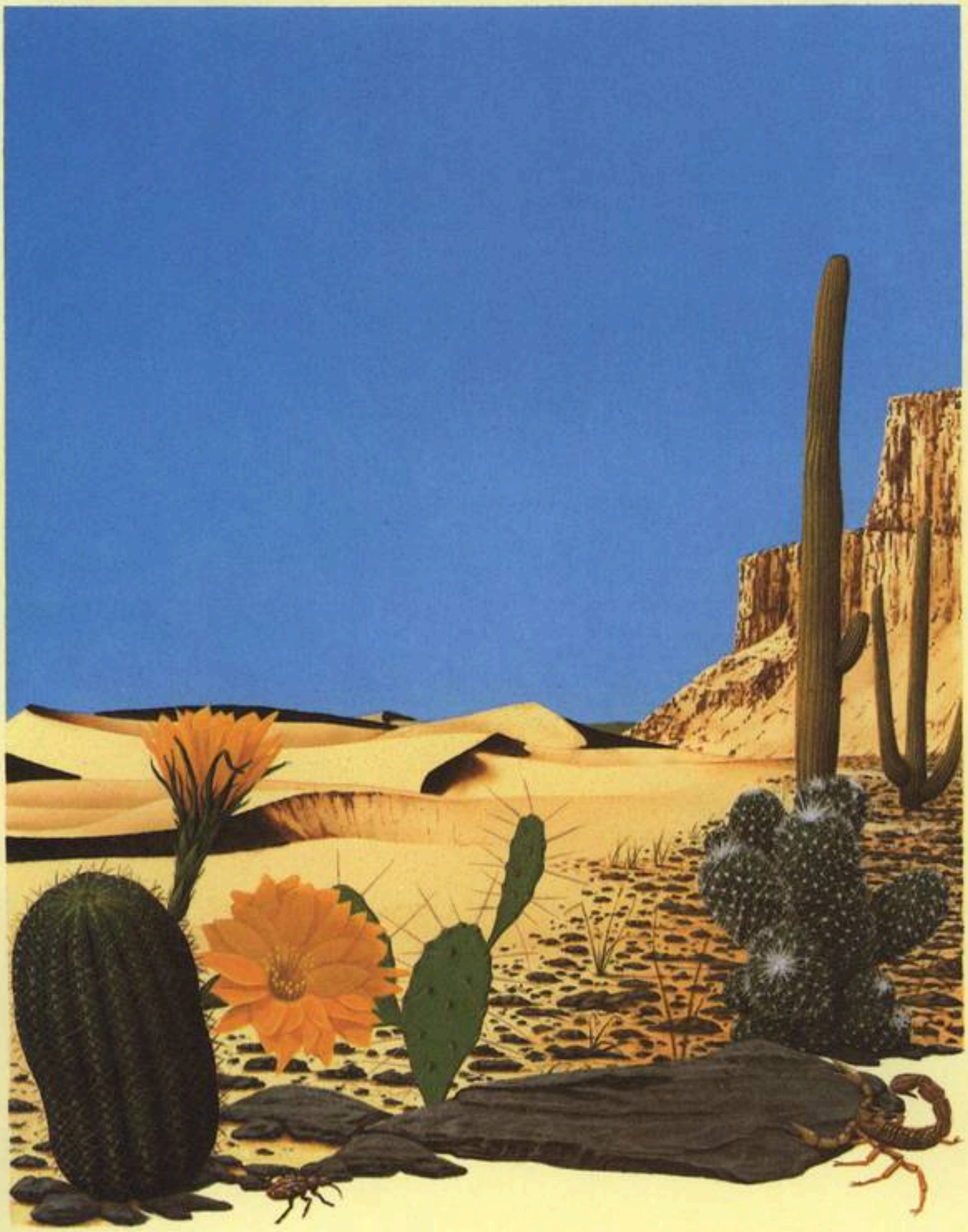
The male groath stands lookout on a prominent rock, alert for signs of danger.

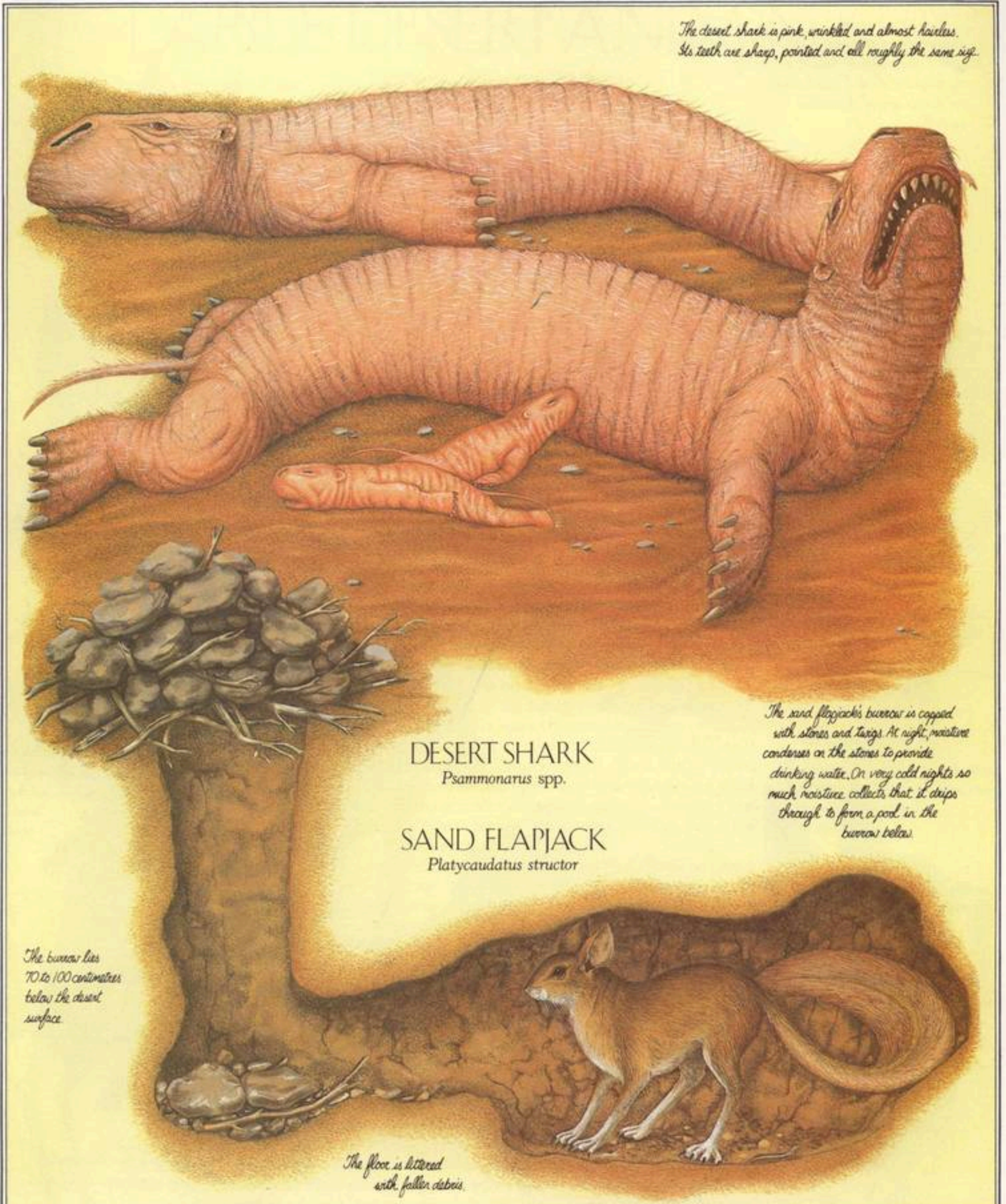
GROATH
Hebecephalus montanus

Although female groaths are well equipped to defend themselves, they will not normally fight unless forced to do so.

The adult shurrack's coat is mottled with dark rosette markings.

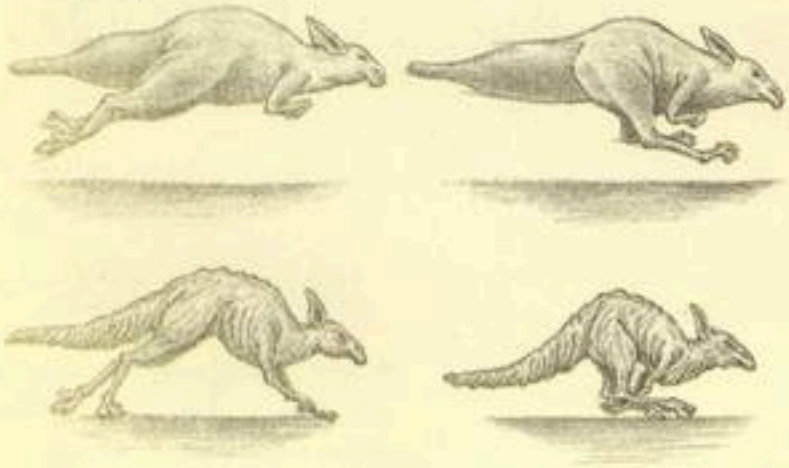
SHURRACK
Oromustela altifera




The desert shark is pink, wrinkled and almost hairless. Its teeth are sharp, pointed and all roughly the same size.
DESERT SHARK
Psammonarus spp.
The sand flapjack's burrow is capped with stones and twigs. At night, moisture condenses on the stones to provide drinking water. On very cold nights so much moisture collects that it drips through to form a pool in the burrow below.
SAND FLAPJACK
Platycaudatus structor
The burrow lies 70 to 100 centimetres below the desert surface.
The floor is littered with fallen debris.

The desert leaper stores fat in its tail. It can survive for up to 3 months without food. It eats mainly the leaves and shoots of desert shrubs and receives most of its moisture needs this way.

When replete with food the desert leaper moves in a series of jumps with its forelimbs folded across its chest. In its emaciated form it runs in a four-legged fashion.

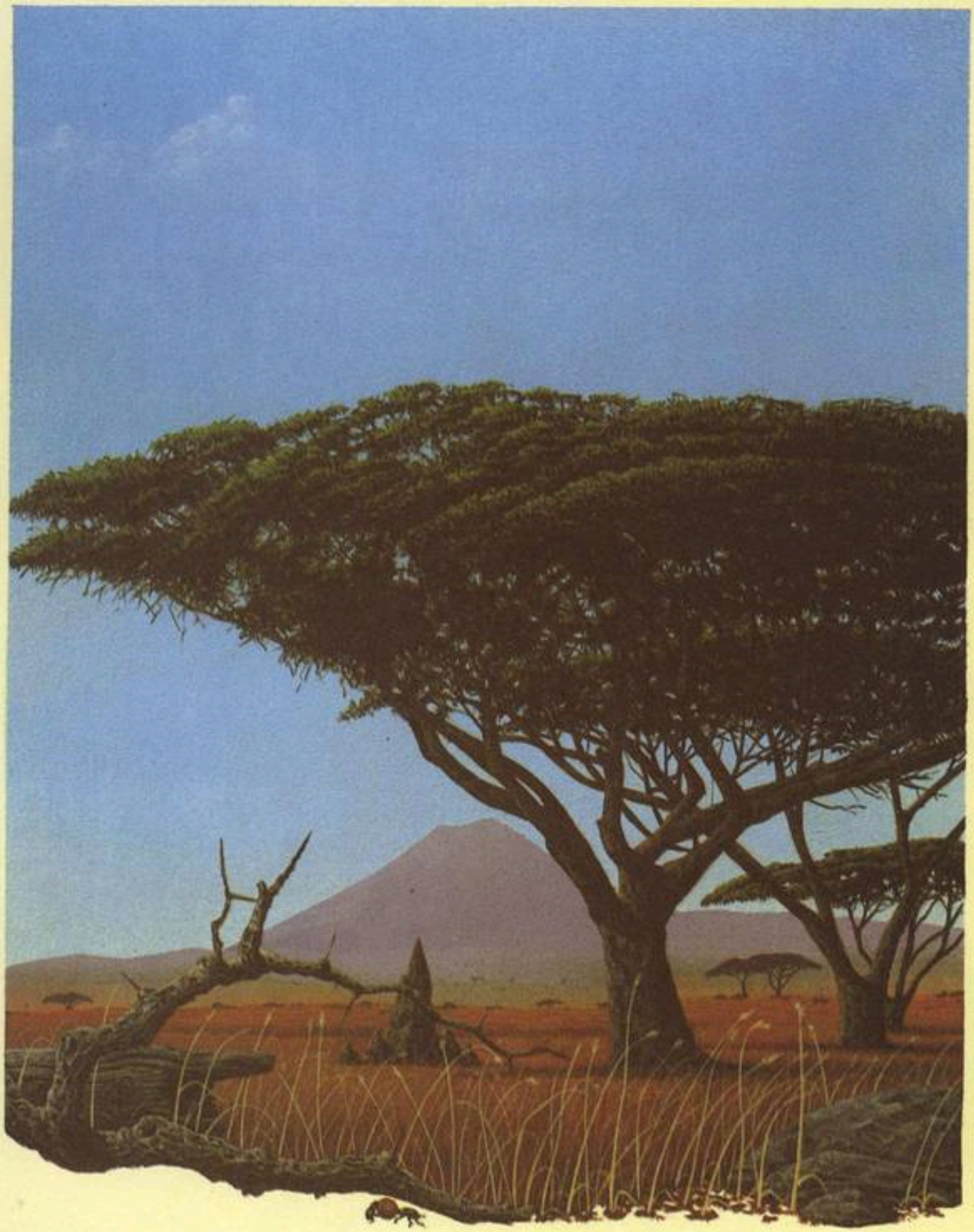


DESERT LEAPER

Aquator adepsicautus

The leaper can lose 30 per cent of its body weight without lasting ill effects.

Both male and female have heavy eyelids and retractable nostril covers as protection against sand.

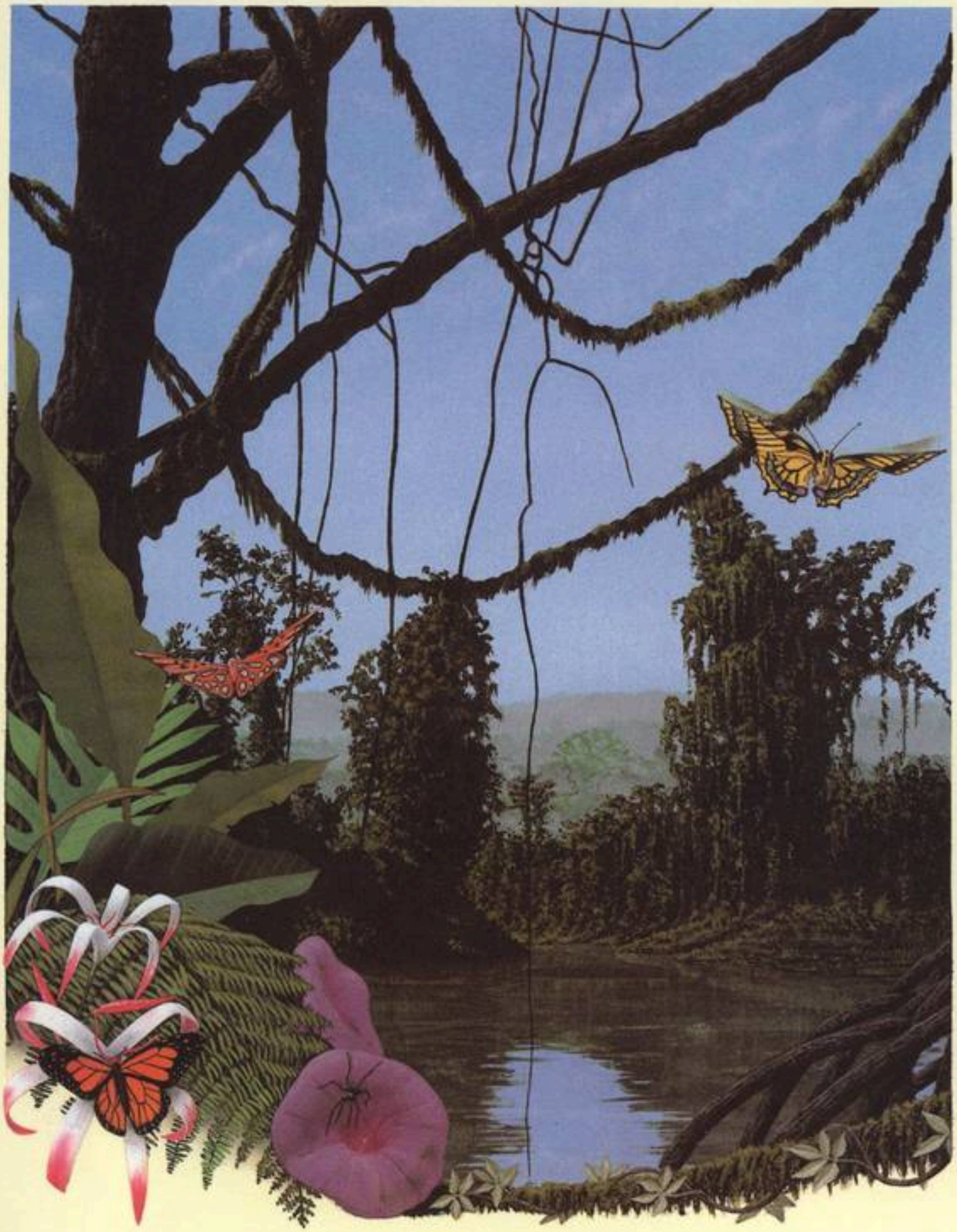


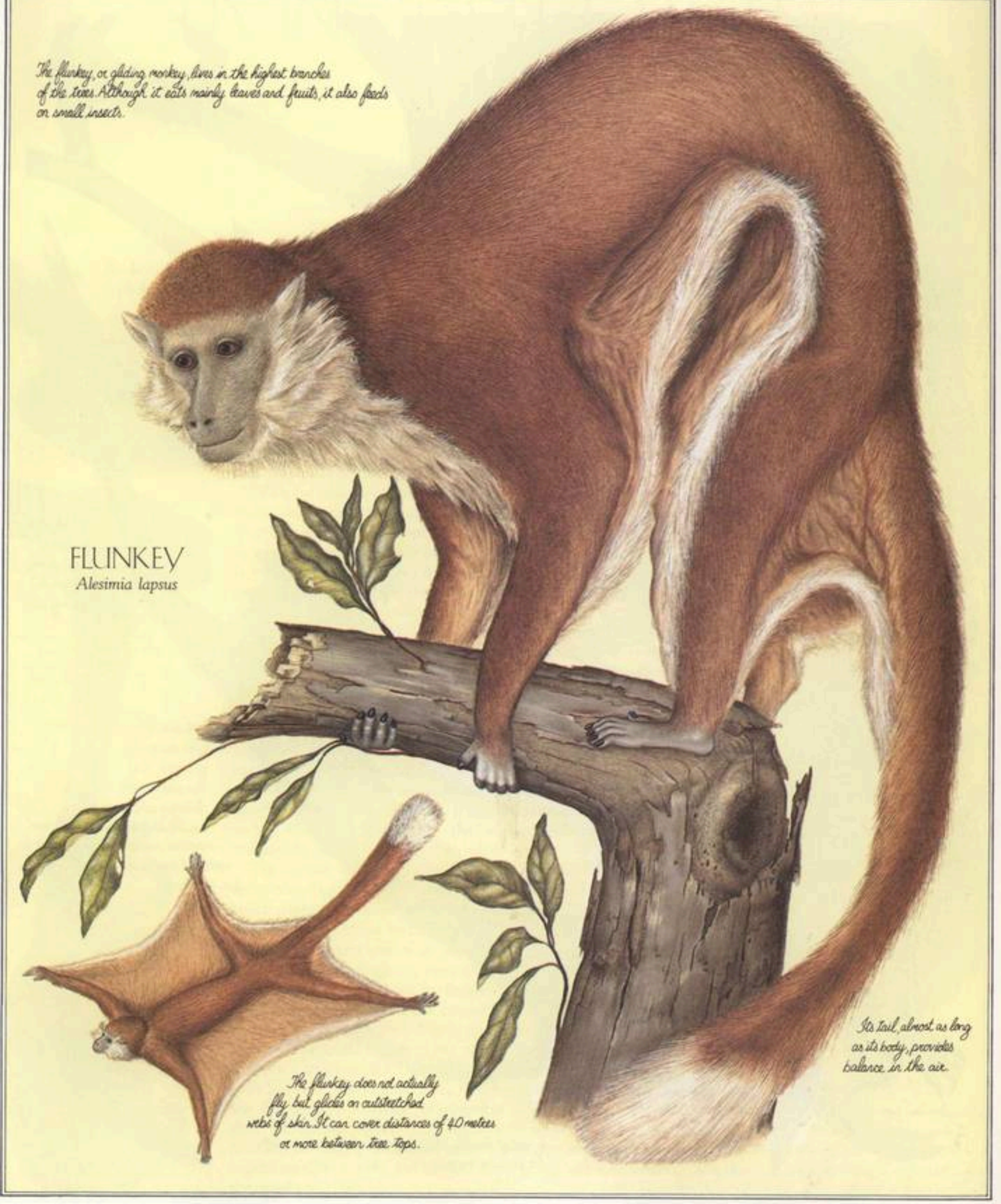
The gigantelope and rundihorn are representative members of a family of tropical heavy grazing animals that are descended from the now extinct antelopes

RUNDIHORN
Tetraceras africanus

GIGANTELOPE
Megalodorcas giganteus

The gigantelopes, like the previous occupants of this ecological niche, the elephants and rhinos, are purely herbivorous.




The flunkey, or gliding monkey, lives in the highest branches of the trees. Although it eats mainly leaves and fruits, it also feeds on small insects.
FLUNKEY
Alesimia lapsus
The flunkey does not actually fly, but glides on outstretched webs of skin. It can cover distances of 40 metres or more between tree tops.
Its tail, almost as long as its body, provides balance in the air.

The swimming monkey is an amphibious primate and lives largely on a diet of fish. In the water its swimming action is essentially frog-like.

SWIMMING MONKEY

Natopithecus ranapes

MUD-GULPER

Phocapotamus lutuphagus

The mud-gulper's tail is studded with horny pads that strengthen and support it out of the water.

SWIMMING ANT-EATER

Myrmevenarius amphibius

SLOBBER

Reteostium cortepellium

Separate races of marsupial slobber are found on different species of tree and creeper, each race's hair varying in texture to blend in with the surroundings. The slobber's young are carried protruding motionless from a pocket in their mother's abdomen.

HIRI-HIRI

Carnophilius ophicaudatus

The herbivorous giantala plucks at the leaves of trees with its long tongue. When drawn erect a fully mature individual stands over 3 metres high.

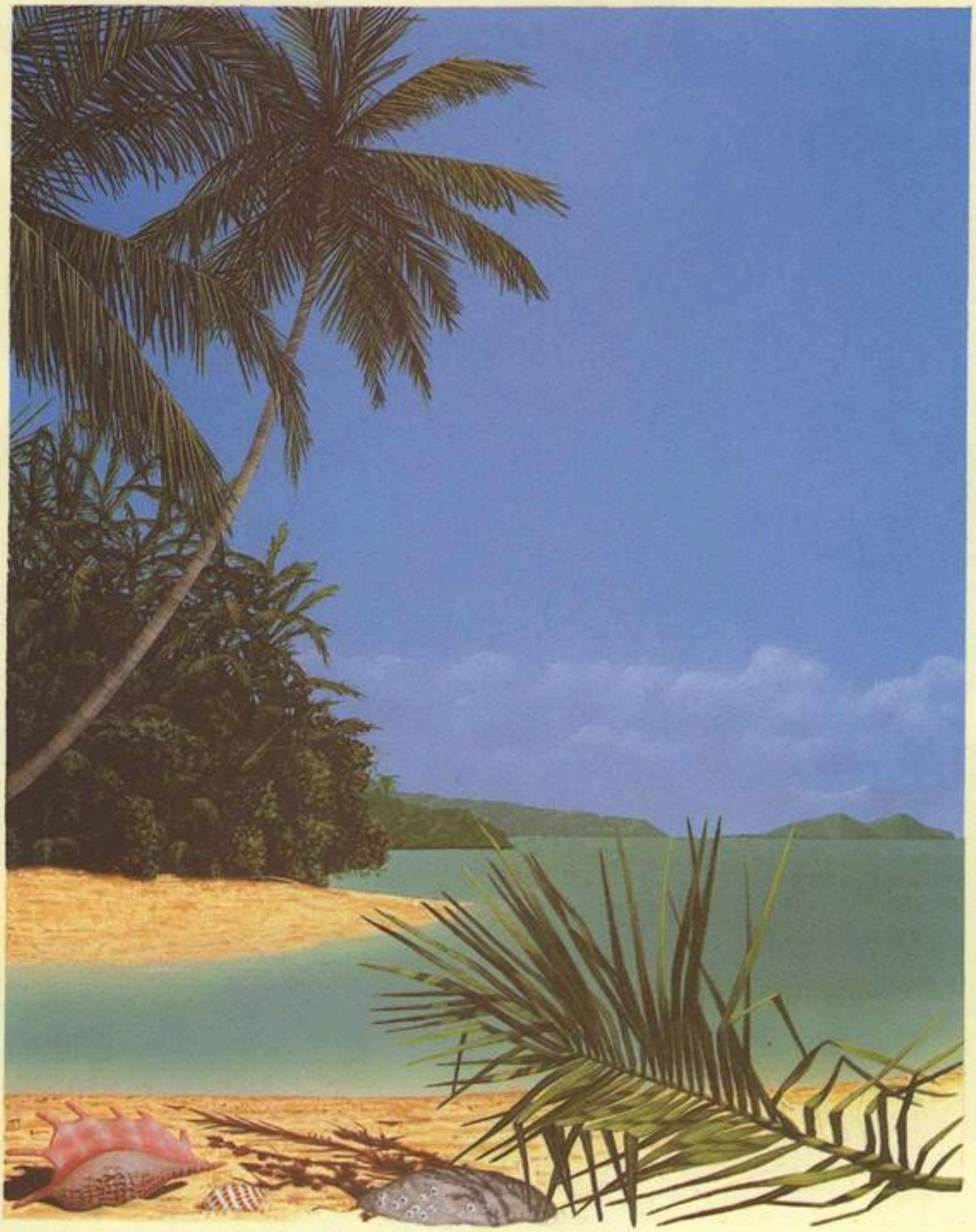
The posset forages in the soil with its long snout for roots and grubs.

GIANTALA
Silfrangerus giganteus

The giantala's muscular tail acts as an extra leg, bearing the creature's weight when standing upright.

POSSET
Thylasus virgatus

The posset, a forest-dwelling marsupial pig, has four tusks, two projecting from its upper jaw and two from its lower jaw.



STRICK

Cursomys longipes

Stricks are very shy creatures and for security live in small herds of up to 12 in number. Their markings break up their shape and make them difficult to pick out at a distance.

Because stricks and wakkas occupy similar ecological niches, they have, in the course of evolution, developed along similar lines from completely different ancestors.

Wakkas are such fast runners that provided they can see a predator approaching, they are always able to outrun it. They are only vulnerable when they have their heads down foraging in the grass.

WAKKA

Anabracchium struthioforme

CLEFT-BACK ANTELOPE

Castratragus grandiceros

The tick bird's egg is held securely by stiff hairs growing in the spinal cleft.

Several families of tick bird can rest at the same time within the double ridge running down the cleft-back antelope's spine.

The cleft-back antelope is a relict of the past. It is one of the few surviving members of the large number of ungulate species that were found throughout the Age of Man.

Cleft-backs are ruminants. They have four stomachs through which their food passes to extract its maximum nutritional content.

PACALIAN WHISTLERS

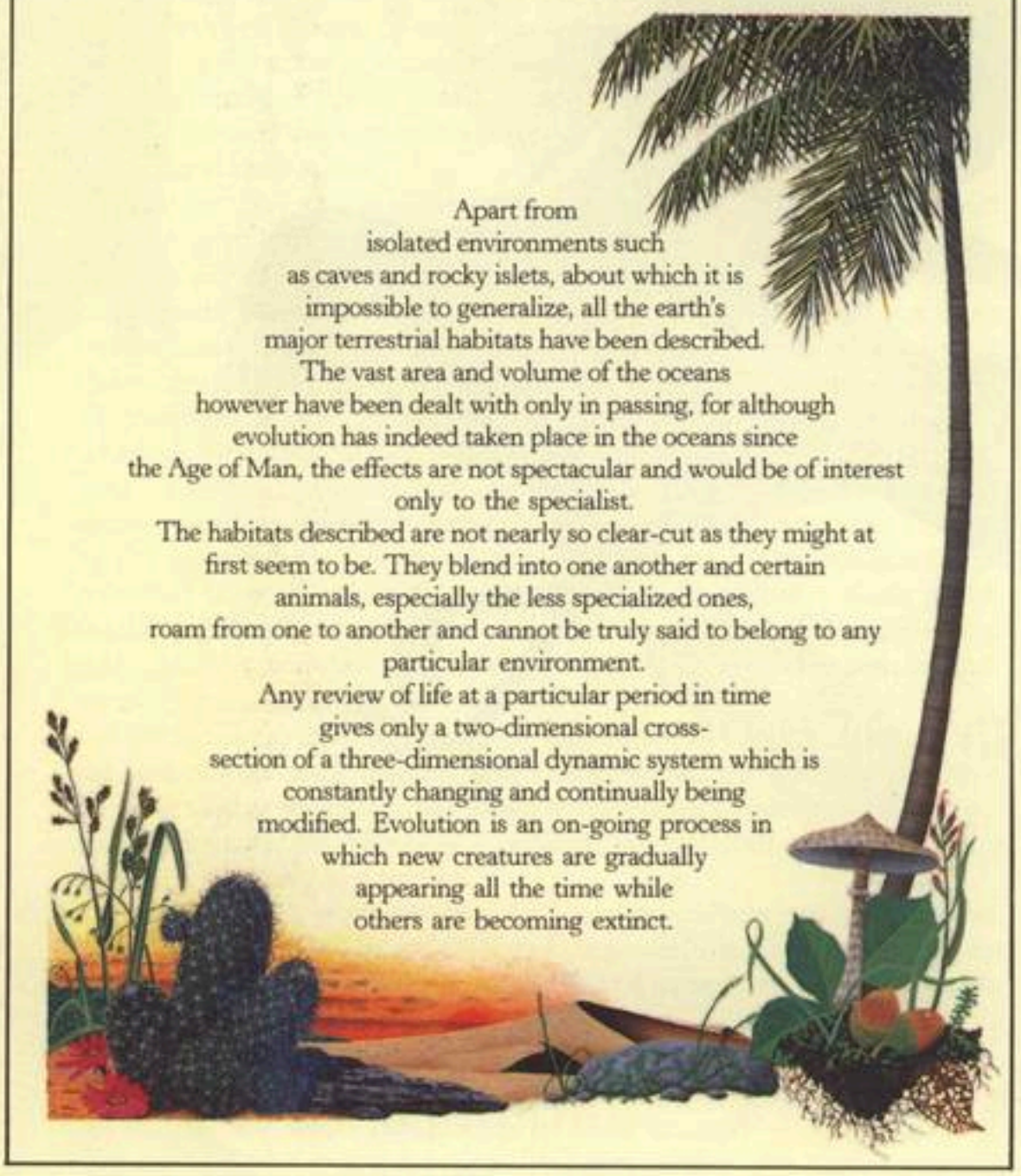
Insulornis spp.

The hawk whistler (Insulornis aviphaga), is deterred by the terratail's snake-like tail.

TERRATAIL

Ophicaudatus insulatus

When threatened the terratail thrusts out its tail and swivels its body under the branch to a position where it cannot be seen.



Apart from
isolated environments such
as caves and rocky islets, about which it is
impossible to generalize, all the earth's
major terrestrial habitats have been described.
The vast area and volume of the oceans
however have been dealt with only in passing, for although
evolution has indeed taken place in the oceans since
the Age of Man, the effects are not spectacular and would be of interest
only to the specialist.
The habitats described are not nearly so clear-cut as they might at
first seem to be. They blend into one another and certain
animals, especially the less specialized ones,
roam from one to another and cannot be truly said to belong to any
particular environment.
Any review of life at a particular period in time
gives only a two-dimensional cross-
section of a three-dimensional dynamic system which is
constantly changing and continually being
modified. Evolution is an on-going process in
which new creatures are gradually
appearing all the time while
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